REPLACED BY ART 34 AMDT

As anticipated, this description refers to a process relating to an ink jet printhead for treating the inner walls of the chambers, feeding ducts and nozzles of said head, in such a way as to offer high resistance against the aggressive agents of the inks employed; it is clear that the process mainly, though not exclusively, concerns the final part of manufacture of the head.

In the description that follows, therefore, the initial steps of manufacture of the printhead will not be described in detail, as these belong to the state of the art, well-known to those acquainted with the sector art, but the process of manufacturing the chambers, relative feeding ducts and injection nozzles, according to the invention, may be considered as applying to a conventional ink jet printhead, made in a first step in a way known in the state of the art.

Depicted in figure 1 by way of an example is a wafer 10 of crystalline silicon, on which die 12 are indicated, constituting a like number of conventional type ink jet printheads, not yet separated; the figure represents one of the die, in enlarged view, in which two zones 13 are indicated in which the driving microcircuits are arranged and the zone 14 enclosing the nozzles 15.

In figure 2, represented by way of non-restrictive example is the section of a conventional ink jet printhead, in the state it is in after a first manufacturing phase, known in itself, in which the manufacturing process has come to the deposition of a sacrificial layer of copper in the zone where the chambers, relative feeding ducts and nozzles will be made; in particular, fig. 2 shows this printhead, in which a die 20 can be seen which is made up of a substrate of silicon 21 covered by a plurality of metallic and dielectric layers, in which an array of microcircuits has been made for driving thermal elements 22, or resistors, for

At the end of this operation, chambers, feeding channels and nozzles are obtained with inner walls completely coated by the layer of noble metals, and therefore effectively protected from the aggressive action of the inks employed.

Naturally the inner shape of the chambers, feeding ducts and nozzles represents the true impression of the sacrificial layer, because the upper surface of the chambers and the ducts connected to them faithfully reproduce the outer surface of the sacrificial layer..

In particular, where the ink jet printhead used is that described in the Italian patent application entitled "Optimized ink jet printhead and relative manufacturing process", filed by the same applicant, and the manufacturing process that this invention refers to is applied, concave-shaped upper inner walls of the chambers and of the feeding ducts connected to them would be obtained, a faithful copy of the corresponding shape of the sacrificial layer made using the process described in the already cited Italian patent application.

In the latter case, the twin advantage would be obtained of great resistance of the chambers and feeding ducts to the aggressive agents in the inks and a more effective prevention of air bubbles becoming attached to particular points of the walls, with optimization of the phase in which the expulsion bubble is developed.

Accordingly the process for producing chambers, relative feeding ducts and protected nozzles, according to this invention, continues starting from the state of progress of manufacture of a printhead, by way of non-restrictive example, of the type described in the cited Italian patent application, shown in fig. 2, and proceeds in the steps described in the flow diagram of fig. 4, integrated with the explanatory drawings in figures 5 to 8.

CLAIMS

1. Process for protectively coating an ejection chamber (35) of an ink jet printhead, to reduce damaging effects of aggressive inks, comprising the following steps:

step a): disposing of a die (20) comprising a silicon substrate (21) covered by a plurality of metallic and dielectric layers (23, 24, 25) in which is made an array of microcircuits for driving of thermal elements (22) for ejection of said ink, and also comprising a sacrificial metallic layer (26), provided with a cast (27) for at least one ejection nozzle (37), said sacrificial layer (26) and said cast (27) defining the inner shape of a chamber (35), of a feeding duct (36) connected to it and of said at least one nozzle (37);

step b): depositing on the outer surface of said sacrificial layer (26), through an electrochemical process, at least one metallic, protective coating layer (30);

step c): applying on said coating layer (30) a layer, the adhesion layer, (31) having a thickness preferably of about 1000 A°, to promote the adhesion of resins on said protective metals (30);

step d): depositing on said adhesion layer (31) a structural layer (32) of non-photosensitive epoxy or polyamide resin, having a thickness preferably between 20 and 60 μm, so as to completely cover said sacrificial layer (26), including the cast (27) of the nozzle (37);

step e): performing a polymerization of said structural layer (32) to increase its mechanical resistance to mechanical and thermal stresses;

step f): performing a planarization of the outer surface (33) of said structural layer (32), by way of a mechanical lapping and simultaneous CMP type chemical treatment (Chemical-Mechanical-Polishing), or other similar process, to uncover the upper cap (34) of

the cast (27) of copper;

step g): removing said sacrificial layer (26) and said cast (27) by means of a chemical etching, using a highly acid bath, formed for instance of a mix of HCl and HNO3 in a solution;

step h): depositing on the outer surface (33) of said structural layer (32), in a vacuum evaporation operation, a protective layer (39) of thickness preferably of approximately 1000 A°.

2. Process according to claim 1, wherein said metallic coating layer (30) is made of nickel-gold;

3. Process according to claim 1, wherein said metallic coating layer (30) is made of palladium-gold.

4. Process according to claim 1, wherein said metallic coating layer (30) is made of rutenium.

5. Process according to claim 1, wherein said protective layer (39) is made of a noble metal..

6. Process according to claim 5, wherein said protective layer (39) is made of chromium.

7. Process according to claim 8, wherein said protective layer (39) is made of magnesium fluoride and oxygen ($MgF_2 + O_2$).

8. Process according to claim 1, wherein said protective layer (39) is made of silica and chromium ($SiO_2 + Cr$).

9. Ink jet printhead, made of a silicon substrate (21) and a plurality of metallic and dielectric layers (23, 24, 25) deposited on said substrate (21), wherein a plurality of chambers (35) for ejection of ink droplets and of corresponding feeding ducts (36),

connected to the former, is produced in one of said dielectric layers (32), said chambers (35) and said ducts (36) being delimited by at least one upper wall (35a), said upper wall (35a) communicating with at least one nozzle (37) for ejection of said ink droplets , **characterized in that** said upper wall (35a) and an inner wall (37a) of said nozzle (37) are coated with at least one metallic coating layer (30), suitable for increasing the resistance of said walls (35a, 37a) to chemically aggressive liquids, in contact with said walls.

10. Printhead as in claim 9, **characterized in that** said upper wall (35a) communicates continuously with said inner wall (37a) of said nozzles (37).

11. Printhead as in 9, or 10, **characterized in that** said upper wall (35a) is delimited by a concave surface.

12. Printhead as in 10, **characterized in that** said inner wall (37a) of the nozzles (37) is delimited by a truncated cone shaped surface having its greater base disposed towards said upper wall (35a).

13. Printhead as in one of the claims from 9 to 12, **characterized in that** said metallic coating layer (30) is made via a deposition of nickel and gold.

14. Printhead as in one of the claims from 9 to 12, **characterized in that** said metallic coating layer (30) is made via a deposition of palladium and gold.

15. Printhead as in one of the claims from 9 to 12, **characterized in that** said metallic coating layer (30) is made via a deposition of rutenium.

16. Ink jet printhead, made of a silicon substrate (20) and a plurality of metallic and dielectric layers (23, 24, 25) deposited on said substrate (20), wherein a plurality of chambers (35) for ejection of ink droplets and corresponding feeding ducts (36), connected to the former, are made in one (32) of said dielectric layers, said chambers (35) and said

ducts (36) being delimited by at least one upper wall (35a), said upper wall (35a) communicating with at least one ejection nozzle (37) of said ink droplets, **characterized in that** said chambers (35), said feeding ducts (36) connected to them and said at least one ejection nozzle (37) are made in the process according to claims from 1 to 8.

17. Process of protectively coating against aggressive liquids hydraulic microcircuits (35, 36, 37) made in a resin (32), comprising the following steps:

step a): disposing of a die (20) comprising a silicon substrate (21) covered by a plurality of metallic and dielectric layers (23, 24, 25), and also comprising a sacrificial metallic layer (26) defining the inner shape of said hydraulic microcircuits (35, 36, 37);

step b): depositing on the outer surface of said sacrificial layer (26), in an electrochemical process, at least one metallic, protective coating layer (30);

step c): applying on said coating layer (30) a layer, the adhesion layer, (31) having a thickness preferably of approximately 1000 A°, to promote the adhesion of resins on said protective metals (30);

step d): depositing on said adhesion layer (31) a non-photosensitive epoxy or polyamide resin (32), having a predetermined thickness and completely covering said sacrificial layer (26);

step e): performing a polymerization of said resin (32) to increase its mechanical resistance to mechanical and thermal stresses;

step f): performing a planarization of the outer surface (33) of said resin (32), through a mechanical lapping and simultaneous CMP type chemical treatment (Chemical-Mechanical-Polishing), or other similar process;

step g): removing said sacrificial layer (26) via a chemical etching, by means of a

highly acid bath, formed for instance of a mix of HCl and HNO3 in a solution;

step h): depositing on the outer surface (33) of said resin (32), in a vacuum evaporation operation, a protective layer (39).

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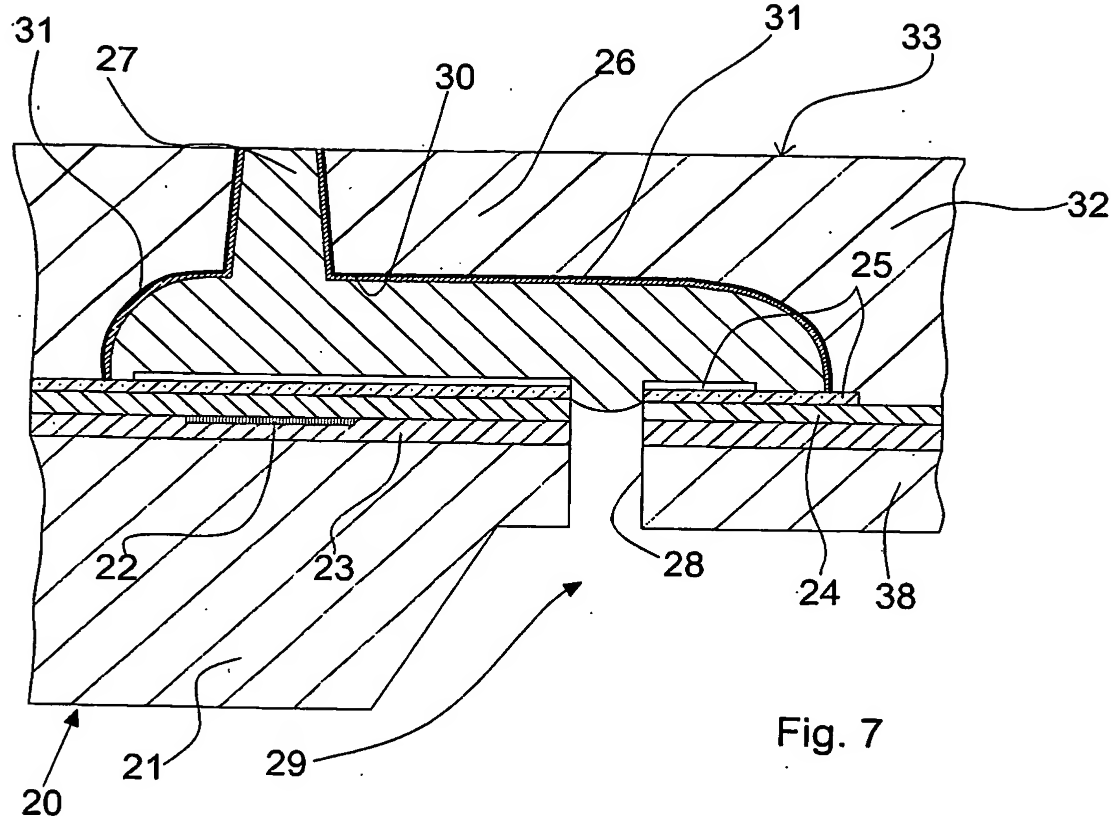
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Fig. 7

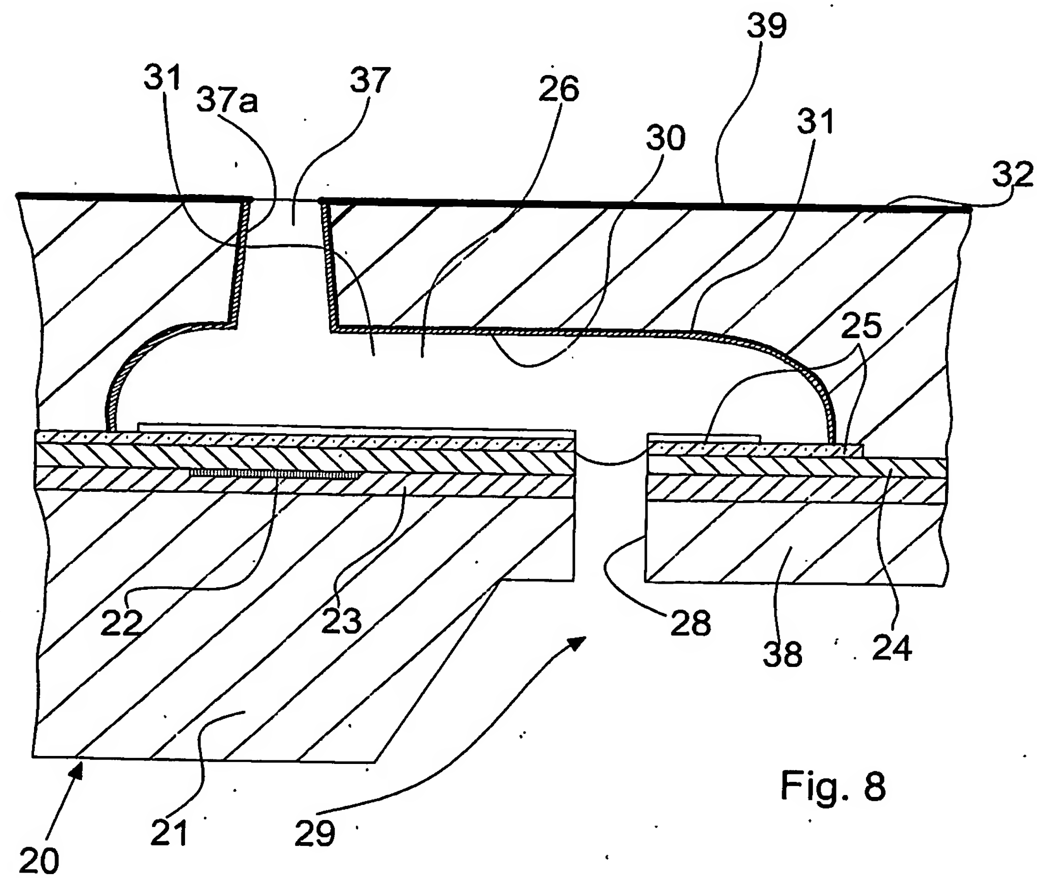
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Fig. 8